Adaptive capacity in Pacific Islands: responding to coastal and climatic change in Nagigi village, Fiji

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ABSTRACT

Coastal communities across the Pacific are increasingly recognized as places of priority for climate adaptation. Pacific Island communities are developing and using strategies to adapt their lives and livelihoods to climatic and environmental risks. Highlighting the case study of Nagigi village, Fiji, we identify adaptation responses to multiple environmental and socio-economic pressures including changing social structures, food insecurity, coastal erosion, extreme weather events and COVID-19. Through a decolonised qualitative methodology, and building on conceptual frameworks of adaptative capacity, we examine six dimensions that shape local adaptive capacity in Nagigi: local assets and resources; experiential and communicated knowledge of socioecological change; social organization; agency and capacity to act (particularly among women); diversity of adaptation options; and Pacific worldviews and values including communal values, commitment to Vanua, and stewardship of local resources. This paper offers insights into how community members understand and respond to multiple pressures, highlighting key dimensions of adaptive capacity. It challenges discourses that focus excessively on the 'vulnerability' of Pacific Islanders by highlighting local adaptation to changing socio-ecological and climatic circumstances.

KEYWORDS: adaptation, climate change, food security, livelihoods, retreat

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INTRODUCTION

Coastal communities, and the ecosystems on which they depend, are exposed to multiple climate change threats. These include sea-level rise, coastal flooding and erosion, changes in the intensity of rainfall events and cyclones, saltwater intrusion of freshwater resources, coral reef bleaching, ocean acidification, increasing water and surface air temperatures, and reduced productivity of local fisheries and agriculture (Cinner et al. 2018; Hanich et al. 2018). There is a pressing need for adaptation that can reduce the adverse effects of climate change-related exposures and risks (Berrang-Ford et al. 2021; Engle 2011; IPCC 2022).

However, adaptation can occur only where there is adaptive capacity. Adaptive capacity is defined as the ability of social and socioecological systems to adapt to change (Currenti et al. 2019; Siders 2018; Warrick et al. 2017). Adaptive capacity is shaped by the conditions, processes and social networks that enable people to anticipate climate risks, minimise adverse impacts, recover, and take advantage of opportunities (Vincent and Cundill 2022).

In this paper we examine adaptive capacity in the coastal community of Nagigi village and surrounding settlements, specifically Bia-I-Cake, in Fiji. In Nagigi village and surrounding settlements, residents are experiencing and responding to climate- and environment-related changes including food insecurity, management of local marine resources, and retreat of households from sites of coastal risk. In the sections that follow, we introduce the case study of Nagigi village and surrounding settlements and outline the research methods. The findings consider the ways in which residents understand and adapt to local threats to food security, marine resources, livelihoods, and habitability. Analysis is organized with reference to six dimensions that shape adaptative capacity: assets and resource distribution; experiential learning about environmental and climatic change; social organisation; agency; flexible adaptation options; and Pacific worldviews and values. Finally, the discussion and conclusion highlight the value of in-depth analysis and understanding of adaptive capacity for climate-affected communities, households and individuals, including in Small Island States (Berrang-Ford et al. 2021; Siders 2018).

LITERATURE REVIEW: ADAPTIVE CAPACITY IN THE PACIFIC ISLANDS

The Pacific Islands Region is often characterized by high climate change vulnerability with adverse impacts for ecosystems, livelihoods, food production and human health, and with island communities positioned as ‘victims’ of climate change (Currenti et al. 2019; Farbotko 2010; IPCC 2022; McLeod et al. 2018). However, Pacific Island communities are increasingly developing and using strategies to adapt their lives and livelihoods to environmental and climatic changes and associated risks. Indeed, community-led adaptation initiatives that use local capacities and resources are both a ‘choice’ and a necessity, given that – to date - limited global climate finance has been available and used in ways that contribute to adaptation in the region (Hidalgo et al. 2021; Remling and Veitayaki 2016). Community-led adaptation in the Pacific Islands includes marine resources protection, prevention of land-loss, relocation, food and water security enhancement, livelihood diversification, migration and mobility, and climate awareness-raising (McNamara et al. 2020).

For example, in response to coastal flooding and saltwater intrusion, women in Palau are growing salt-tolerant crops and farming in less climate-vulnerable areas (McLeod et al.

2018). In the interior village of Nawairuku, Fiji, adaptation strategies include relocation of farm plots and housing away from flood- and landslide-prone areas, supporting vulnerable residents during times of stress (e.g. after Tropical Cyclone Winston), livelihood diversification, and resilient building design (Currenti et al. 2019). A study of water stress in Kiribati underscored the role of belief in ability to manage and past experiences with water stress in determining adaptation actions (e.g. purchase of rainwater tanks, construction of wells, household relocation) (Kuruppu and Liverman 2011). A study in Northern Pentecost in Vanuatu documented use of Indigenous and local knowledge to forecast weather, plant disaster-resilient crops, and construct tropical cyclone shelters (Rarai et al. 2021). In Namdrik Atoll in the Marshall Islands, a community-designed plan has sought to address development, conservation and adaptation imperatives through sustainable use of marine and terrestrial resources, solid waste and water lens management, a pearl farm, and coastal protection (e.g. replanting with native species) (Jarillo and Barnett 2021). Several studies have demonstrated that Pacific Island communities adjust subsistence farming practices, often using Indigenous and local knowledge, to increase resilience to climate variability and extreme weather (c.f. Granderson 2017; Nalau et al. 2018; Rarai et al. 2021). And a growing number of studies identify the ways Pacific Island communities engage in (im)mobility to adapt to climate-related risks (c.f. Piggott-McKellar and McMichael 2021; Ruehr 2022).

While documenting examples of adaptation initiatives and actions in the Pacific Islands, much of this empirical research also underscores key dimensions of adaptive capacity. It highlights the diverse ways in which adaptation actions are enabled or constrained by local resources, gender roles, social networks, knowledge and information including Indigenous and local knowledge, perceptions of risk, and multi-scalar interactions from the local to the institutional level (Buggy and McNamara, 2016; Kuruppu and Liverman 2011; Nalau et al. 2018; Rarai et al. 2021).

Nonetheless, the determinants of adaptive capacity are far from settled (Siders 2018). What are the factors that enable communities to undertake adaptation initiatives? Adaptive capacity is increased where people and populations have available resources, such as financial and social capital, and ability to access and use these resources for adaptation action (Brown and Westaway 2011; Cinner et al. 2017). There are also constraints to adaptive capacity that might include information deficits around the consequences of climate change and available adaptation options, inadequate political will and institutional capacity to undertake adaptation, limited financial resources, and inequitable distribution of benefits of adaptation initiatives (Biesbroek et al. 2013; Eriksen et al. 2015; Fazey et al. 2016; Nalau et al. 2015; Thomas et al. 2021). However, there is no universal agreement on the enabling and constraining factors that determine adaptive capacity, nor any clear basis on which to compare adaptive capacity across communities and societies. Efforts to advance understanding of adaptative capacity, regardless of its spatial scale, are identified as a priority area for research (Andrijevic et al. 2023).

Adaptive capacity frameworks of relevance to Pacific Islands highlight key dimensions including: access to assets and resources; knowledge and experience of climate change risks; social organisation and ability to cooperate and act collectively; availability of adaptation strategies; and agency to implement adaptive actions (Cinner et al. 2018; Warrick et al. 2018). The Pacific Adaptive Capacity Analysis Framework (PACAF) specifically highlights the centrality of Pacific worldviews and values for informing and determining adaptation outcomes (Warrick et al. 2018). Key dimensions of these frameworks (i.e. Cinner et al. 2018; Warrick et al. 2018), and research-based insights into Pacific Island adaptive capacity, are summarized in Table 1.

Table 1: Adaptive capacity in the Pacific Islands Region

Dimensions	Description
Asset and resource distribution	Socially differentiated access to material, financial, technological and service resources: e.g., land, fishing areas, ecosystem services, income, health services, education, transport, infrastructure, water and sanitation.
Experiential and communicated knowledge	Information about causes and consequences of climate risks and socioecological change: i.e. scientific knowledge, local and Indigenous knowledge, and experiential learning.
Social organization	Social organization – individuals, households, families, clans, communities, local leaders, and organisations – that enables (or inhibits) cooperation, social support, and resource and knowledge sharing.
Agency	Ability to act, including both community leaders and community members: to choose, implement and manage responses to climate-related events and emergent risks.
Adaptation options	Availability of diverse adaptation strategies.
Worldviews and values	Adaptation options that align with and are guided by worldviews and values (i.e. Indigenous Pacific, local, Western science, and religious worldviews and values).

Further, people do not adapt to climate impacts in isolation from other processes. For example, climate impacts degrade island ecosystems in intersection with pollution, overuse of resources (e.g., overfishing and intensive land and water use), and unsustainable development and mining (Balzan et al. 2018). Individuals, households and communities adapt to multiple stressors – environmental, social, economic, and political conditions – that alter, amplify, or mitigate the impacts of climate change (McCubbin et al. 2015; Nightingale et al. 2020). They respond to climate impacts and concurrent stressors as part of broader efforts to live well.

STUDY SITE AND METHODS

Study site: Nagigi village and Bia-I-Cake settlement

This paper focuses on Nagigi village and Bia-I-Cake settlement. Nagigi village is a small fishing community located on Savusavu Bay in Cakaudrove Province on Vanua Levu, the second largest island of Fiji. It has a population of around 630 people (iTaukei – Indigenous Fijian), comprising of 126 households. There are also six smaller settlements outside the main village boundary: Vunikoko, Wailailai, Bia-I-Loma, Bia-I-Cake, Waitunutunu and Dewala. Bia-I-Cake settlement has a population of around 60 people across 12 households (excluding those that live elsewhere in Fiji and overseas). There are two churches (Methodist and Seventh Day Adventist), one meeting hall, one water tank with connected water-piping system, one primary school (Naleba Primary School), and electricity supplied from Savusavu town. All homes are made from tin or iron and timber, and have piped water and sanitation facilities. The village and settlements are on sloped terrain, with several houses located in low-lying coastal sites and most set back from the coastline or on the hillside. Nagigi village and surrounding settlements are characteristic of tropical coastal and island communities that rely on fishing and marine resources for livelihoods and food security, many of which are vulnerable to climate impacts including sea-level rise, inundation and erosion, and disruptions to reef ecosystems and small-scale fisheries (see also Barnes et al. 2020).

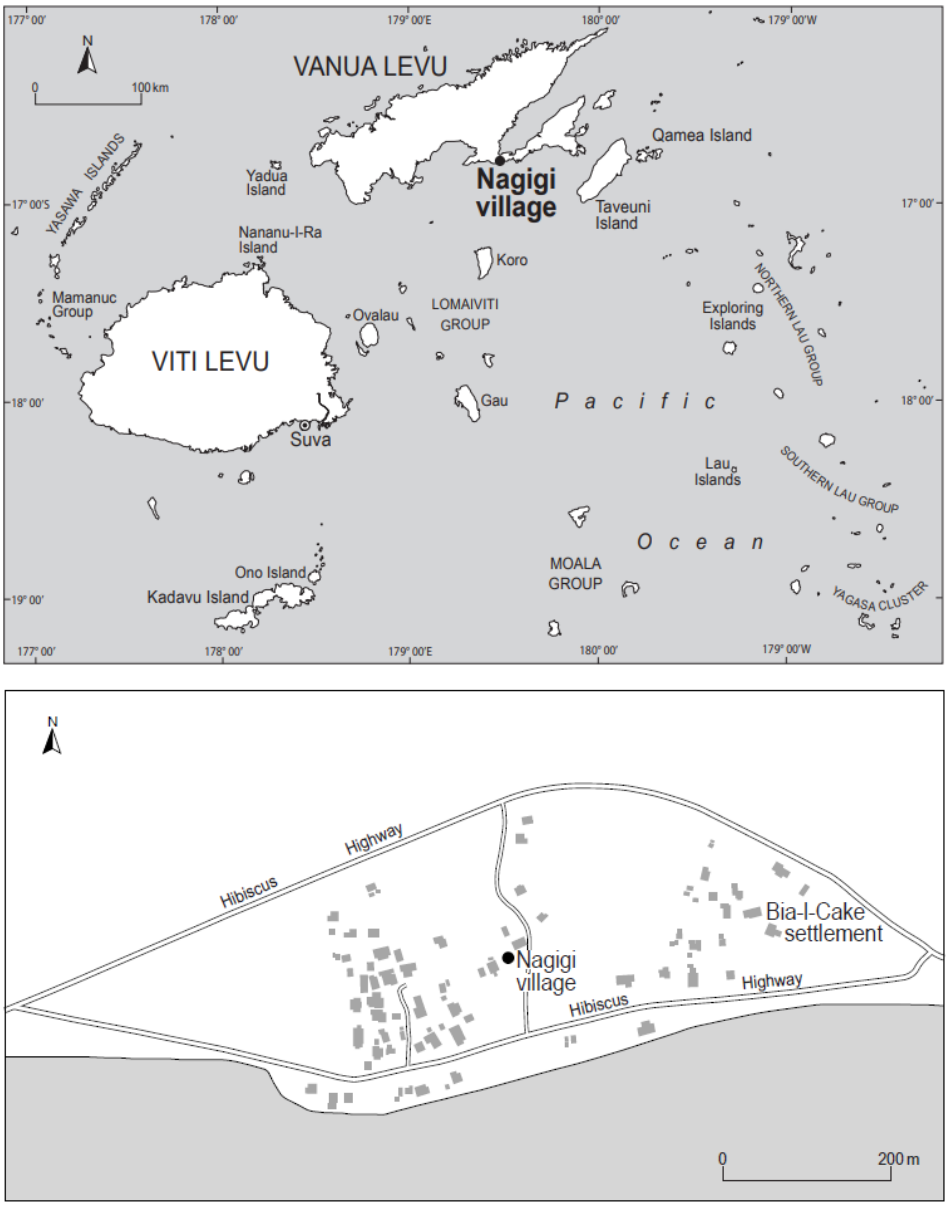

Figure 1: Map of Fiji (top) and Nagigi village and Bia-I-Cake settlement (bottom) *(prepared by Chandra Jayasuriya)*

Methods

Qualitative data collection, using culturally-appropriate methods, took place in Nagigi and surrounding settlements during October-November 2021 (two researchers) and March 2023 (three researchers). The field-based research team included one Anglo-Australian researcher (author CM) and two iTaukei (Indigenous Fijian) researchers (authors MY and AL). The iTaukei researchers (MY, AL) worked closely with local leaders and community members to organise and support fieldwork, ensuring community involvement and establishing good relationships with residents. CM and MY collaborated on the design of research tools; all authors contributed to theoretical and empirical analysis.

Researchers in the Pacific increasingly use decolonising research methods that are sensitive to local language, knowledge, practices and understanding (see Nabobo-Baba 2008; Suaalii-

Sauni and Fulu-Aiolupotea 2014; Vaioleti 2013). Qualitative data collection included *talanoa* group discussions and interviews and observations. These methods align with sociocultural norms in iTaukei communities in Fiji and enable culturally appropriate discussion and storytelling. Specifically, group and individual interviews were conducted as Talanoa, a Pacific Island practice of face-to-face dialogue and exchange of ideas and emotions that allows the storyteller to structure the conversation and that fosters respect, trust and understanding (Nabobo-Baba 2008; Vaioleti 2013). We recognise that our positions and identities shaped the research process (Petzold et al. 2020).

A theme list was used to guide *talanoa*, while allowing people to orient discussions. Guiding themes included: background information (e.g. age, gender, household composition, length of residence in village, livelihoods); local experiences of disaster and climate- and environmental change; climate change adaptation strategies including both in situ adaptation and retreat; impacts of COVID-19; experiences of migration and mobility; women and resilience, specifically the successes and challenges of women-led village projects; worldviews and values; and perceptions of the future.

Data collection included 56 participants (see Table 2), noting that several people participated at both time-points (i.e. 2021 and 2023). All participants were iTaukei (Indigenous Fijian) and – through a purposive sampling approach - included different ages (18 to 88 years), genders, and social status (e.g. community leaders, elders, younger people, members of community-based clubs). Six group talanoa were conducted: two with men, one with youth (aged 18-37 years), and three with women. Fifteen individual talanoa were conducted: eight in 2021 (5 women; 3 men), and seven in 2023 (3 women; 4 men). This paper has a particular focus on women's perspectives on climate adaptation and local/Indigenous knowledge (McLeod et al. 2018).

Table 2: Summary of methods and participant numbers, by gender

METHOD	PARTICIPANTS	NUMBER
Group talanoa (n=2)	9 men	5 men (2021); 4 men (2023)
Group talanoa (n=1)	8 youth	3 women / 5 men (2021)
Group talanoa (n=3)	24 women	8 women (2021); 8 women (2021); 8 women (2023)
Individual talanoa	15 people	5 women/3 men (2021); 3 women/4 men (2023)
TOTAL	56 people	35 women / 21 men

Talanoa discussions and interviews were conducted in English or in local languages and dialects and conducted in people's homes and communal spaces in the village and surrounding settlements. They lasted approximately 1 to 1.5 hours and were digitally recorded and later transcribed. Data were analysed thematically (wave 1: GC, MY; wave 2: CM, MY) based on pre-determined themes around climate and environmental change, livelihood diversification, and adaptation purposively investigated variables as well themes that emerged inductively from the data.

The project received Human Research Ethics Approval by the University of Melbourne (ethics ID: 1851729.1). All participants reviewed and discussed a plain language summary of the research and provided verbal consent for their participation, as approved the Ethics Committee. The Government of Fiji provided a research permit (Fiji Department of Immigration 2017), and Cakaudrove Provincial government and Nagigi community leaders approved the research, following *sevusevu* (traditional kava presentation) and discussion of the proposed research.

FINDINGS: ADAPTIVE CAPACITY IN NAGIGI VILLAGE

The sections below focus on six dimensions that shape adaptive capacity: asset and resource distribution; experiential and communicated knowledge; social organization; agency; flexible adaptation options; and worldviews and values (see Table 1 above).

Assets and resource distribution

> *We love this village because it's so close to the sea. The fish were in abundance and the crab were in abundance. But now we have to travel longer to go and find fish, and even the crabs are not as many as they used to be. (Woman, 2023)*

Nagigi and surrounding settlements have access to diverse assets and resources including land and fishing areas under customary tenure, various income sources, and services and infrastructure. Most residents are farmers and fishers and derive incomes, livelihoods and food from ocean and land resources. Nagigi is also a tour site for neighboring resorts and visiting cruise ships to Savusavu. There are two family-operated homestays. Several residents work in nearby hotels, resorts, estates and businesses in Savusavu. Many residents are mobile: seasonal workers travel to Labasa and western Viti Levu for sugarcane harvesting; some work in Vanua Levu and Viti Levu, primarily in housing and road construction and tourism; some have worked on the 'Survivor' reality television series which has previously been filmed nearby; a few villagers work overseas in New Zealand, Australia, USA, UK and Europe. Many households receive remittances from family members. Some people who studied, lived and worked in other parts of Fiji or overseas have returned - permanently or periodically - to start small-scale businesses (e.g. kava, banana, cassava farming).

As with many Pacific Island communities, the ocean and small-scale fisheries are key to subsistence food security, livelihoods, culture and life (Albert et al. 2015; Hanich et al. 2018; Kitolelei et al. 2021). As one man said, *'I think the food security for the village is in the sea and the land*' (2021). Coastal fisheries in Nagigi are managed under governance arrangements that include customary tenure over nearby reefs and marine habitats. Residents explained that in the past '*this place used to be very rich in all types of fish*' (man, 2023) and that '*fishes were abundant and more than enough to sustain our daily needs*' (woman, 2021).

Residents are concerned, however, about declining size, availability and diversity of fish and seafood both in the coastal reef and the lagoon surrounding their village. They explain, for example, that '*we can't find fish easily, not compared to previous times*' and that *'some fish species we used to see before are no longer around'*. Women in particular explained that the local totem fish, *deu,* that used to appear in large quantities between November and December has declined: '*we would be lucky to get five or ten fish nowadays*'. Many expressed concern that they are unable to reliably provide food for their families because of declining fish availability:

> *Sometimes I just get so depressed and stressed when I return from fishing and it's not enough for my family. I feel so down and so sad because I am thinking of my children. Sometimes I cry at night just thinking of what our food will be the next day. I am sure other women here go through the same thing. (Woman, 2021)*

Nagigi village and surrounding settlements also have access to ancestral land that households use for small-scale commercial farming and subsistence crops (e.g. kava, cassava, taro, coconut, banana, some fruits and vegetables). People practice subsistence farming and fishing, sell excess resources for income, and farm crops for income (e.g. kava).

In 2021, the return of residents following COVID-19 reportedly provided opportunity to strengthen farming for both subsistence and income, with returned residents assisting with farming, planting, and production of *yaqona* (kava). However, a few residents are concerned that the increase in commercial farming – particularly of kava – destroys native forests, degrades land, and disrupts watersheds.

So, with adaptive capacity shaped by the availability (or lack) of different forms of capital – including assets and resources – Nagigi village and surrounding settlements have important resources that can provide a foundation for adaptation: land and fishing areas under customary tenure, diverse income sources, and food security albeit with threats to food security under changing environmental and climate conditions.

Experiential and communicated knowledge

> *We see what's happening.* (Man, 2021)

> *They see when it's high tide; sometimes the sea is coming further onto the land. So there's a lot of sea intrusion into the plantations, flooding even on land where it never used to be, beach erosion.* (Woman, 2023)

Nagigi and surrounding settlements experience climatic and environmental changes. Nagigi has experienced several cyclones in recent years; the most damaging was Tropical Cyclone (TC) Winston in February 2016. Coastal erosion, flooding, sea-level rise, extreme weather events and ecosystem changes are understood by residents as climate-related threats. Residents spoke about local observations and experiences of environmental and climatic changes including altered weather patterns, rainfall variability, higher sea levels, storm surges, coastal erosion, coral reef degradation, warmer ocean temperature, and increased frequency and severity of cyclones. They said, for example, that the *'weather does not seem to be following its normal pattern'*, '*sea level rise inundating the land and eating away the shoreline*', *'[cyclones] have become frequent'*, and during '*storm surges the waves just come so fast*'. Many spoke with sadness of the erosion of their coastline, with one woman explaining that '*this whole stretch of the village was beautiful, white sandy beaches and we had these long coconut trees*', but the coconut trees and beach have now been '*washed away*'.

Residents said these changes affect their daily lives and decision-making, explaining that climate change affects the '*small things that we do, the choices that we make on a daily basis'* (man, 2021). For example, during one group *talanoa* women discussed how increasing ambient temperatures and warming seas mean they must fish further out near the reef:

> *The heat is so unbearable. So when we go out fishing . . . . we have to go further out where the water is cooler, deeper. Here it's warmer towards the beach…and we have to walk further out, near the open reef where it's cooler*. (Woman, 2023)

Residents suggested the decline in fish and seafood (including the local totem fish *deu*) and reef damage was due in part to changing climatic and environmental conditions: altered weather, warming oceans, changing ocean currents, and coral bleaching. As one man said, '*I think it's because of the weather changing, climate change, and it's affecting our ocean too*' (2023). But they also spoke of wider environmental pressures including deforestation, land excavation, modification of riverways during the construction of local highways, sand removal for construction of houses, damage to coral reefs by residents (including through the traditional practice of *vutuguru* – discussed below), and untreated wastewater and sewage flowing into the sea.

Further, during the early stages of the COVID-19 pandemic many people returned to the village as border closures, curfews and lockdowns had severe economic impacts including loss of tourism and unemployment (Leal Filho et al. 2020); many suggested that this further contributed to the '*decline in fish stocks*' with more people fishing in local waters.

In sum, residents have experiential knowledge of socioecological changes – such as changing weather, coastal erosion, altered frequency of cyclones, declining fish stocks – which affect their lives and livelihoods and are a precursor to adaptation decision-making.

Social organisation

> *Our elders had the spirit of respect for each other and for traditional protocols, which nowadays is no longer there. And that's why the leadership is a bit tattered; that's touching every area of living of our community, the village*. (Woman, 2023)

Nagigi village and surrounding settlements are organised into traditional social structures. In Nagigi, there are four *mataqali* (clans): Valelevu, Korolevu, Vuniyaro and Wailada. Residents of Bia-I-Cake settlement are from the *mataqali* Korolevu. There are three government representatives in the village: one Turaga-ni-koro (village headman) and two Nasi-ni-koro (village nurses). An iTaukei way of life is sustained, with households and clans sharing burdens, providing material assistance and support, and collaborating on initiatives. These social connections provide crucial support in times of need with, for example, *mataqali* members helping to repair damaged homes following TC Winston.

However, residents note a decline in well-functioning social organization and leadership in recent years, citing loss of the 'Vanua structure', erosion of tradition, lack of appointments to key traditional leadership roles (i.e., Tui Ni Sa, Tui Ni Yavusa, Marama Ni Yavusa), inappropriate transfer of authority to those in lower leadership positions, disregard for authority, and lack of respect for elders. One woman explained this makes it difficult to progress ideas and work together:

> *We have the head of the mataqalis, [but] the one who is supposed to be head of the vanua of the whole village is the Tui Ni Sa, that title has not been filled yet . . . A lot of things try and move forward but can't because there is no leader and the mataqalis are pushing their own agendas (2023)*

While the Tui Ni Sa is traditionally responsible for calling village meetings with all mataqali, this role has been assigned to the Turaga Ni Mataqali resulting in exclusion of some mataqalis. Residents reported that laws that maintain traditional village life and safeguard the *Vanua* are not sustained and respected. There is an appointed *Turaga Ni Koro* (village head), who is a government representative. However, lack of traditional leaders means '*people will do whatever they want because no-one has the right authority to correct them*' (woman, 2021). Older residents expressed concern that '*times have changed*' with youth reluctant to take on responsibilities (*veibilibili*), and life becoming less communal.

The central narrative is that traditional social structures continue to provide crucial support during times of environmental crisis. However, with the erosion of tradition and the Vanua structure it is considered increasingly difficult to respond to pressing local needs including those linked to environmental and climate risks.

Agency

> *We asked what if we women had our own income generating project, just with our clan. Perhaps this could help with the things needed . . . in our settlement, Mataqali and in our very own households and families. (Woman, 2021)*

Despite accounts of declining traditional structures and communal organisation, in Nagigi and surrounding settlements new forms of agency are emerging to respond to environmental and socioeconomic challenges. Here, we highlight the agency of women in development and adaptation initiatives.

The Bia-I-Cake Women's Club comprises 16 women and focuses on land and marine ecosystem management, climate change and disaster, and sustainable livelihoods. The club formed in 2020, after the start of the COVID-19 pandemic, to work on small communal projects – *solesolevaki* – such as weaving mats, that could provide income for their households and clan. More recently the club has addressed broader challenges of food security and income generation from fishing and farming under changing environmental and climatic conditions. As one woman said, '*the change in climate and the decline in resources made it harder to sustain a living*'.

In October 2020, the Bia-I-Cake Women's Club was one of ten recipients of the United Nations Development Programme (UNDP) Global Environment Facility Small Grants Programme in Fiji. Funding was provided for two projects: (i) an aquaculture project (three fish ponds for tilapia, carp, prawn) (see Fig. 2); and (ii) a coconut project (to produce flour, coir, meal mix, virgin coconut oil, desiccated coconut). Women received training on finance, farm management (aquaculture), and coconut pre-processing. They also set up an initiative recycling plastic waste to make jewellery and decorations. These projects are managed and implemented by the Bia-I-Cake Women's Club in collaboration with Ministry of Agriculture, Ministry of Fisheries, Ministry of Women, Department of Cooperatives, Soqosoqo Vakamarama Cakaudrove, Api Food Consulting, Kava Korp and Maravu.

Figure 2: Bia-I-Cake women's club aquaculture project

Women explained that projects: leverage material, cultural and social resources; support entrepreneurship and financial independence; generate income for women and their families and community; enable development of skills; strengthen bonds within the clan;

increase women's voice and respect in the settlement and village; promote food security; and offer an adaptive response to a changing climate and other socioecological pressures:

> *We wanted to display our skills, we wanted to be financially independent and share our skills. We wanted to have food security as well. You know with the changing climate we have experienced, it's not like before when we use to go fishing. (woman, 50, 2021)*

While residents continue to engage in coastal fishery, the Bia-I-Cake women's club is developing aquaculture as a new livelihood and economic opportunity, and a way to adapt to declining coastal fish stocks. Members take responsibility on a rotating basis for feeding fish, cleaning the pond, weeding, and maintaining infrastructure and water flow: '*we want to make sure that there is proper water flow into the pond. Sometimes the pipes are broken so we have to mend or fix*' (woman, 2023). The first harvest of tilapia was carried out in October 2021 and shared among all 16 families in Bia-I-Cake settlement with money earned from sales saved in a group bank account. In 2023, women reported that sale of farmed fish (at markets and from the roadside, and promoted via live streaming on social media) is covering operational costs and providing income as well as offering food security:

> *The fishpond is going well. We had six harvests, sold six times now . . . Right now, the tilapia we sell at $7 per kilogram, prawns will be selling at about $18. I do live streaming . . . that's where we get a lot of the sales. (Woman, 2023)*

By 2023, the women's group had registered as a cooperative and initiated further projects including: a reforestation project with the Ministry of Forestry, a factory to make coconut flour (i.e. with automated husking machines), training women on food handling, and projects to mitigate coastal erosion (e.g. planting mangroves, coastal protection using coconut tree trunks) with the Ministry of Agriculture.

Reportedly inspired by the success of the Bia-I-Cake Women's club, the Nagigi Women's Committee are planning a new Village Evacuation Centre, with the support of the organisation Seacology. At the December 2021 village meeting, the women's committee proposed the new Evacuation Centre (also supported by the development committee) and the proposal was unanimously endorsed. The women of Nagigi have set up a project committee and delivered a presentation to the Turaga ni Vanua. A site has been earmarked and men tasked to undertake traditional protocols to request the land at the proposed site.

Diverse adaptation options

In addition to the efforts of the Bia-I-Cake Women's Club and the Nagigi Women's Committee, residents of Nagigi describe other ways they are adapting to environmental and climatic changes, including initiatives to manage marine resources, and relocation and retreat of houses from sites of coastal risk. This is indicative of adaptive capacity, in terms of the willingness and capabilities of households and groups in Nagigi and surrounding settlements to use resources for adaptive action (Cinner et al 2018).

First, there are village-wide efforts to manage and rejuvenate marine resources including through fish wardens, closure of fishing grounds, and plans to establish a locally-managed marine area. Certified local fish wardens, trained by the Ministry of Fisheries, inspect villagers' catch: undersized or breeding fish are supposed to be thrown back to the ocean, a fine issued, and the responsible person reported to the Ministry of Fisheries. However, wardens reportedly look the other way when people catch smaller fish to provide food for their families, and because it is uncomfortable issuing fines to village residents: as one man

asked, *'how do you tell your uncle, "that's an undersized fish and I am going to fine you"?'.* Further, some nearshore customary fishing grounds have been closed and fish stocks are reportedly beginning to rejuvenate, with a woman explaining that '*as this ban is still in place, we can see these types of fish beginning to emerge once again*'. And, in 2023, the Nagigi village committee was in discussions with the Provincial Council and a local non-government organisation to set up a locally-managed marine area (*tabu*) in which the community takes responsibility for management and monitoring of marine and fishing areas, building on customary tenure and fishing rights (O'Garra et al. 2023; Pauli et al. 2023; Robertson et al. 2020). Residents hope that establishment of a *tabu* will deliver both ecological benefits (e.g. regeneration of corals, mangrove renewal, increased fish diversity and supply) and social benefits (e.g. increased tourism, marine resource knowledge and management, sustainable livelihoods). Members of the Bia-I-Cake women's club explained that establishment of a *tabu* area with more '*limited places for people to go fishing'* would further increase the significance of the Bia-I-Cake aquaculture initiative as an alternative local food and income source.

Second, while marine resource management is a village-wide concern, some environmental risks – coastal erosion, flooding, destructive waves – are experienced specifically by households close to the shore. Short-distance relocation and retreat has been undertaken by several households in response to '*the intensity and regularity of these cyclones and inundation of the coastal areas*' *(man, 2021)*, as their houses were damaged and even washed away. In particular, TC Winston led to significant damage of coastal properties: *'the water literally picked up the house and put them on the road, and those were the ones who relocated*' (Woman, 2023). After TC Winston, government representatives reportedly announced in a village meeting that houses near the sea should '*relocate further inland*' as they would not assist those households again with post-disaster rebuilding. Members of two households explained that relocation was 'smooth' because they had access to *mataqali* land and built new homes using local materials and government hurricane relief funding. Indeed, their accounts indicated that while they moved the physical location of their homes, this was not viewed as a "relocation" as such because short distance moves allow people and households to remain in a place of belonging (see also Latai-Niusulu et al. 2023):

> *Our relocation was smooth because we didn't move to a new location, we just moved to our own land, our mataqali land.* (2023)

> *We used our own material and old timber from the village and the government gave us hurricane relief assistance to rebuild the houses.* (2023)

However, some households required permission from other mataqali to negotiate land tenure for their relocation. As one man explained, '*I had to prepare two tabua [whale tooth] and present this to the head of the mataqali' (2021).* And others explained that it was '*not an easy decision, to pull down your home and start all over again'*, but they moved to ensure that their '*children and grandchildren are safe and protected from the risks of climate'* (woman, 2021). Other households that sustained significant damage and were only able to rebuild in situ or retreat a few metres inland, within mataqali land, remain concerned about cyclone risk and considering relocation: *'I think the only solution is to get away from there; relocation . . . I am always worried about the next cyclone'* (man, 2023). And older residents are encouraging their children to build new homes on higher ground, as a form of slow 'generational retreat'.

However, many people are reluctant to relocate to higher ground because they have lived in their family home for generations and enjoy being close to the sea. As one man explained*:*

> *leave us here. I think if I don't smell or hear the ocean for one day I would be devastated. Living here also provides me with strength to persevere with life like how my ancestors did* (2021).

Others are reluctant to relocate because their ancestral land is far from the village; '*if we wanted to build a house it would be in the bush that belongs to our mataqali, Vuniyaro . . . We can't just take our house down and build somewhere else'* (man, 2023). And some households are unable to relocate because they do not have available *mataqali* land or lack resources such as building materials and money. In 2021, one older widowed woman explained she fears '*the big waves*', but lacks the land and resources needed to relocate and is reluctant to lose connection to the place she gave birth, lived with her husband and raised a family. She explained '*there are so many good memories in this house, my husband's memories too. It is a bit difficult to let go of that*'.

Worldviews and values

> *I think we are very connected, stewardship, that's always been a part of who we were and who we are*. (Woman, 2023)

Pacific worldviews, values and knowledge are central to climate resilience and adaptation, and foundational to long histories of stewardship of ecosystems and responses to environmental change through mobility within and between islands, sharing of resources and diversified livelihoods (Nalau et al. 2018; Rarai et al. 2021). Residents of Nagigi express the importance of sustained connections to place and Vanua. Some explained that that their umbilical cord was '*thrown out in the sea*' or planted under a coconut tree following their birth, creating connection to place. Residents refer to stewardship of local ecosystems and resources, and responsibility to protect a place – '*the land, the water and the fish that came with that*' - given to them by the Tui Cakaudrove. However, they are also worried about decline of long-held values, loss of social cohesion, and reduced stewardship, citing economic pressures and an individual focus on '*making money*' rather than communal living, loss of traditions such as offering *sevu* at the church following first harvest, and loss of traditional knowledge '*that our forefathers taught us*'. Many women attributed the decline in *deu* to the loss of traditional fishing protocols and knowledge ('*the old women those days used to tell us how to traditionally catch this fish*').

Nonetheless, people acknowledged that iTaukei values and practices change over time: worldviews, knowledge and practices are shaped by diverse actors, changing local environments, and 'old' and 'new' forms of knowledge (see Rarai et al. 2021). For example, the customary fishing practice - *vutuguru* - damaged the coral, as people '*used to break the corals and destroy the fish hiding place…as the fish had nowhere else to hide, and they swam straight to the nets and got caught*' (woman, 2021); *vutuguru* is no longer practiced by villagers in Nagigi, in a bid to restore their reefs and replenish fish stocks. The Bia-I-Cake Women's Club is also reshaping values and practices. Women in iTaukei communities typically have a limited role in governance and decision-making; as one woman explained, '*gender roles are split along traditional lines and this is the main obstacle for us women to contribute to community resilience'* (2021). Yet the Women's Club has found ways to contribute to adaptation while pushing against cultural limits; they gained support from the wider community (elders, men and youth), drive their own initiatives, and provide project updates at village meetings (*bose vakoro*). One woman from Bia-I-Cake explained, *'women have the capacity to build a sustainable, secure and thriving community'.* So, in Nagigi village, people change practices, values and worldviews – as socioecological conditions shift

and new forms of knowledge are accessed – including because of their commitment to stewardship, connection to place and Vanua, and the impetus to build a hopeful future.

DISCUSSION

This paper, documenting adaptive capacity and actions in Nagigi village and surrounding settlements, underscores the important role of local resources, knowledge, social networks, agency, adaptation options, and worldviews. While the limits to adaptation are significant, it is important to be attentive to and support effective and often locally-led adaptation efforts (Hayward et al 2020). In Nagigi village and settlements, residents report climate change-related impacts: coastal erosion, warming oceans, rising seas, damaged reefs, declining fish stocks, increased intensity of extreme weather events. While residents attribute these changes in part to climate change, they are linked to other socioecological challenges (Golden et al. 2014; McCubbin et al. 2015) including deforestation, increased commercial farming, modification of riverways, overuse of (marine) resources, destruction of coral reefs, and loss of tradition knowledge and leadership. This is a reminder that people experience and adapt to climate change risks in conjunction with other socioecological, development, disaster and resource management imperatives (Jarillo and Barnett 2021; Robinson 2020).

Nonetheless, residents of Nagigi and Bia-I-Cake settlement hope to remain on their land, to adapt to changing socioecological conditions, and to sustain their livelihoods using local resources. Residents report that their adaptive capacity (i.e. ability to respond to local impacts of climate and environmental changes) and adaptation actions are shaped by access to assets and resources, experiential knowledge of climate and environmental change, social organisation, agency, adaptation options, and worldviews and values (see Table 2) (see Cinner et al. 2018). As populations respond to co-occurring climate impacts (e.g. sea level rise, coastal erosion) and non-climate stressors (e.g. over-fishing), it is increasingly important to understand how and why people respond to stressors and risks, and the factors that shape adaptive capacity (Green et al. 2021).

Table 2: Adaptive capacity in Nagigi village and Bia-I-Cake settlement

Dimensions	Description
Asset and resource distribution	local tangible assets and resources, particularly land and fishing areas under customary tenure
Experiential and communicated knowledge	experiential knowledge of climate and environmental change, including changes to weather, coastal erosion, decline of coral reefs and fish supply, and extreme weather events
Social organization	established and supportive social networks, clans and governance systems albeit with widespread concern about erosion of Vanua structures and traditional decision-making and governance
Agency	new forms of agency in response to environmental and socioeconomic challenges, and ability to gain support and resources from provincial government and external agencies
Flexible adaptation options	diverse adaptation options such as livelihood diversification, new forms of resource management, and short distance retreat of households
Worldviews and values	sustained connections to place and Vanua and stewardship of local ecosystems and resources

Local forms of community-led adaptation include efforts to diversify livelihoods including through a new small-scale aquaculture initiative led by women of Bia-I-Cake settlement, marine resource management (e.g. ending the practice of *vutuguru*, a proposed locally-

managed marine area), short-distance retreat and relocation of some low-lying homes and households away from sites of coastal risk albeit while remaining within the village/settlements as a place of belonging, and disaster preparedness including a proposed evacuation centre. Importantly, while these adaptation strategies are broadly described as community-led, their acceptability, availability and impacts can be uneven. This is unsurprising given that, as with many Pacific Island communities, in Nagigi there are complex distinctions and boundaries particularly along lines of gender and clan (McNamara et al. 2020). For example, only those low-lying households with available mataqali land are readily able to relocate, and only women from Bia-I-Cake settlement are involved in newly-established coconut and aquaculture livelihood initiatives. Further, community-led adaptation often entail multilevel interactions with government and institutions (Siders 2018), including provincial and national government, donor agencies and non-government organisations. In sum, in Nagigi village and surrounding settlements diverse forms of adaptation are underway, they are unevenly available and experienced, and while community-initiated and driven they also connect with wider governance and funding structures.

Documenting adaptive capacity and community-led adaptation matters. A significant body of adaptation research and analysis focuses on macro-level processes of formal governance and institutional actors, adaptation frameworks and policies, and mobilisation of financial resources (IPCC 2022). In 2011, a review by Berrang-Ford et al. (2011) indicated that the major focus of adaptation research to date had been on vulnerability assessments and intentions rather than adaptation actions. In subsequent years, adaptive capacity and actions have been increasingly researched at the scale of households and community, including in connection to specific climatic hazards (e.g. floods), threats to resources (e.g. water) and sectors (e.g. agriculture), and – less frequently - climate-related threats to ecosystems, biodiversity, economic growth, urban development and human health (Siders 2018). However, there has been relatively limited recognition of autonomous adaptation by communities, households and individuals (Berrang-Ford et al. 2021), and limited empirical knowledge about why, who and how local actors adapt to climatic change (Barnes et al. 2020; Bartelet et al. 2022; IPCC 2022). And most studies still focus on large, developed nations with only 1-2% of academic studies reporting adaptive capacity and adaptation responses in Small Island States (Siders 2018; Berrang-Ford et al. 2021; Latai-Niusulu et al. 2023; Nalau and Verrall 2021). So, this case study of adaptive capacity and community-led adaptation in Fiji contributes to a small sub-set of adaptation research. Importantly, it highlights the significant role played by women in driving adaptation actions.

This research and analysis has limitations; three are noted here. First, it has not sought to measure the outcomes and effectiveness of adaptation in terms of, for example, economic benefits, health and wellbeing, vulnerability reduction, good governance, social equity and justice, and transformative challenges to power structures (Singh et al. 2022). Second, it reports on adaptive capacity and adaptation actions in Nagigi village which - while examining the 'localness of adaptation' - makes it difficult to generalise features and contexts of effective adaptation (Biesbroek et al. 2018; Nalau and Verrall 2021). Third, while community-led adaptation is promoted as an effective and appropriate response to climatic risks (McNamara and Buggy 2017), adaptive capacity – e.g. access to resources and capacity to act - is shaped by multiscalar processes and inequities including histories of colonisation, access to global climate finance, multilevel governance processes, and availability of material, technological and institutional resources (Adger et al. 2005; Jarillo and Barnett

2021). The focus on community-led adaptation in Nagigi obscures these macro determinants of adaptive capacity (Nalau et al. 2015).

CONCLUSION

As Pacific Island communities continue to experience climate and environmental change, there is a need to support and build local adaptive capacity and action. This paper highlights intersecting experiences of climate change risks and other socioecological stressors, adaptive capacity, and local forms of adaptation. It highlights the myriad ways in which people in Nagigi and surrounding settlements maintain their lives and livelihoods in the face of climatic and ecosocial change, with notable diversity in adaptive responses that include natural resource management, livelihood diversification, retreat and relocation of households, and 'soft' coastal protection measure. Highlighting the central importance of social organization to adaptive capacity, these local processes of adaptation both build on and challenge structures for community organisation and governance and methods of managing resources. Women and women's groups in particular are organising themselves in new ways that increase access to resources, diversify livelihoods, respond to coastal change, and enable agency. This paper contributes to empirical knowledge of local adaptive capacity and locally-led adaption action in the Pacific Island region.

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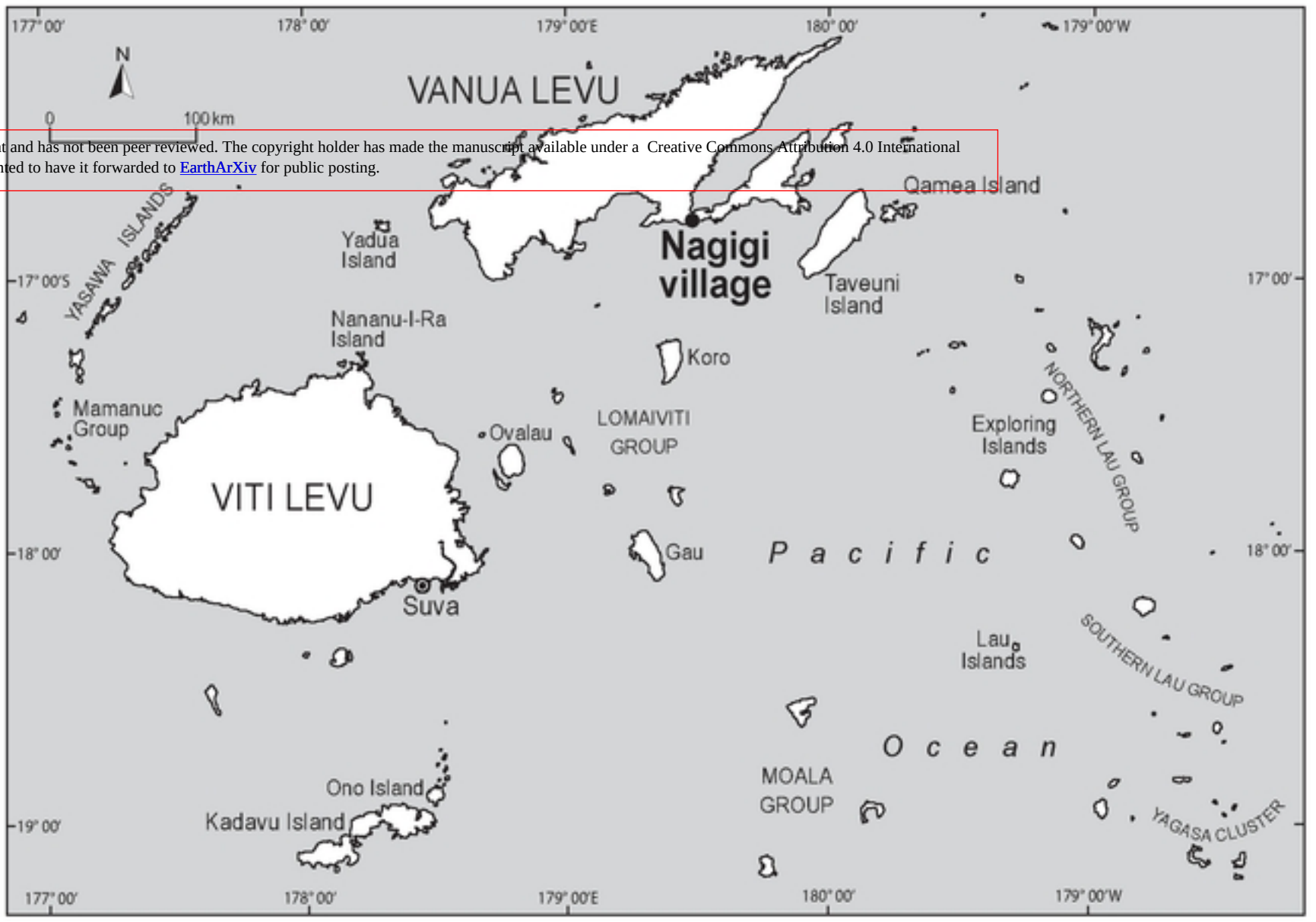

Figure 1a

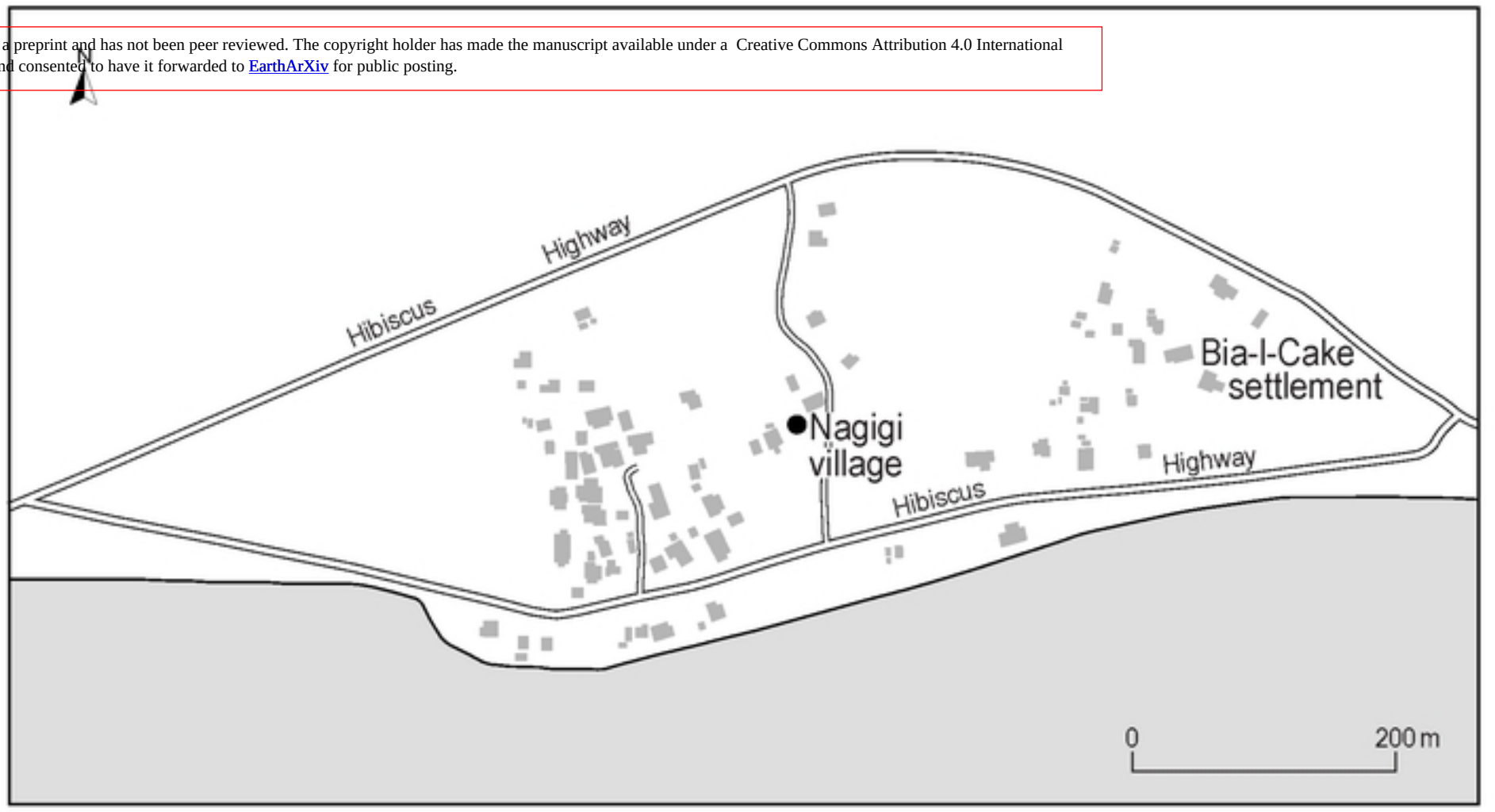

Figure 1b

Figure 2